

I claim:

1. A low-boron, high-barium concentration glass fiber composition comprising:

less than about 1 weight percent boron;

5 from about 5.5 to about 18 weight percent barium oxide;

from about 10 to about 14.5 weight percent alkali oxide;

from about 4 to about 8 weight percent alumina;

from about 1 to about 9 weight percent alkaline earth oxide, excluding barium oxide;

10 from about 2 to about 6 weight percent zinc oxide;

from about 0.1 to about 1.5 weight percent fluorine; and

a balance of the glass fiber composition being silica.

2. The glass fiber composition of claim 1, wherein the boron is present as B_2O_3 , alkali oxide is present as Na_2O or K_2O , and alkaline earth oxide is present as CaO or MgO .

3. The glass fiber composition of claim 1, wherein the alkali oxide is present as Na_2O and K_2O and alkaline earth oxide is present as CaO and MgO .

4. The glass fiber composition of claim 1, further comprising less than about 0.2 weight percent of one or more compounds selected from the group consisting of MnO , SrO , Li_2O , TiO_2 , ZrO_2 and Fe_2O_3 .

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5. A low-boron, high-barium filter comprising:
glass fibers comprising,
about 0 to 1 weight percent boric oxide;
from about 6 to about 16 weight percent barium oxide;
30 from about 10 to about 14.5 percent R_2O , wherein R_2O is a mixture of sodium oxide and potassium oxide;
from about 4 to 8 weight percent alumina;

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from about 1 to about 9 weight percent calcium oxide and magnesium oxide;

from about 2 to about 6 weight percent zinc oxide;

from about 0.5 to about 1.5 weight percent fluorine;

5 a balance of the glass fibers being silica; and

wherein the glass fibers have an average diameter of from about 0.1 μm to about 8.15 μm .

6. The filter of claim 5, wherein the average diameter of the
10 glass fibers is from about 0.1 μm to about 3.0 μm .

7. Low-boron, high-barium fine-diameter glass fibers comprising:

15 less than about 1 weight percent of B_2O_3 ;

from about 5.5 to about 18 weight percent BaO ;

from about 10 to about 14.5 weight percent of Na_2O and K_2O ;

from about 4 to about 8 weight percent of Al_2O_3 ;

from about 1 to about 9 weight percent CaO and MgO ;

from about 2 to about 6 weight percent ZnO ;

20 from about 0.1 to about 1.5 weight percent F_2 ;

less than about 0.2 weight percent of MnO , SrO , Li_2O , TiO_2 , ZrO_2 and Fe_2O_3 ; and

a balance of SiO_2 .

25 8. The glass fibers of claim 7, wherein the glass fibers have an average diameter of from about 0.1 μm to about 3.0 μm .

9. A low-boron, high-barium glass fiber composition comprising:

less than about 1 weight percent of boric oxide;

30 from about 6 to about 16 weight percent barium oxide;

from about 10 to about 12.5 weight percent of alkali oxide;

from about 5 to about 6 weight percent of alumina oxide;

from about 1 to about 9 weight percent alkaline earth oxide;
from about 2 to about 5 weight percent zinc oxide;
from about 0.1 to about 1.0 weight percent fluorine; and
a balance of the composition being silica.

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10. The glass fiber composition of claim 9, wherein the glass fiber composition forms glass fibers having an average diameter of from about 0.1 μm to about 3.0 μm .

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11. The glass fiber composition of claim 9, wherein boron is present as B_2O_3 , alkali oxide is present as Na_2O and K_2O , and alkaline earth oxide is present as CaO and MgO .

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12. The glass fiber composition of claim 9, further comprising less than about 0.2 weight percent of one or more compounds selected from the group consisting of MnO , SrO , Li_2O , TiO_2 , ZrO_2 , and Fe_2O_3 .

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13. A low-boron, high-barium glass fiber composition comprising:
less than about 1 weight percent of boron;
from about 6 to about 16 weight percent barium oxide;
from about 10 to about 12.5 weight percent of alkali oxide;
from about 5 to about 6 weight percent of alumina oxide;
from about 1 to about 9 weight percent alkaline earth oxide;
from about 2 to about 5 weight percent zinc oxide;
from about 0.1 to about 1.0 weight percent fluorine;
a balance of the composition being silica; and

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wherein the glass fiber composition forms glass fibers having an average diameter of from about 0.1 μm to about 8.15 μm .

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14. The glass fiber composition of claim 13, wherein the glass fibers have an average diameter of from about 0.1 μm to about 3.0 μm .

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15. A low-boron, high-barium HEPA or ULPA filter comprising:
glass fibers comprising,
less than about 1 weight percent of B_2O_3 ;
from about 6 to about 16 weight percent BaO ;
from about 10 to about 12.5 weight percent of Na_2O and K_2O ;
from about 5 to about 6 weight percent of Al_2O_3 ;
from about 1 to about 9 weight percent CaO and MgO ;
from about 2 to about 5 weight percent ZnO ;
from about 0.1 to about 1.0 weight percent F_2 ;
less than about 0.2 weight percent of MnO , SrO , Li_2O , TiO_2 , ZrO_2 ,
and Fe_2O_3 ;
a balance of the filter being SiO_2 ; and
wherein the glass fibers have an average diameter of from about
 $0.1 \mu m$ to about $8.15 \mu m$.

16. The filter of claim 15, wherein the glass fibers have an
average diameter of from about $0.1 \mu m$ to about $3.0 \mu m$.

17. A method of making glass fibers for use in forming HEPA or
ULPA glass filters having a low-boron concentration comprising:
fiberizing a molten glass composition, wherein the glass
composition comprises less than about 1 weight percent of boron, from about
5.5 to about 18 weight percent barium oxide, from about 10 to about 14.5
weight percent of alkali oxide, from about 4 to about 8 weight percent of
alumina, from about 1 to about 9 weight percent alkaline earth oxide, from
about 2 to about 6 weight percent zinc oxide, from about 0.1 to about 1.5
weight percent fluorine, and a balance of the composition being silica;
spinning the molten glass composition to produce glass fibers; and
attenuating the glass fibers.

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18. The method of claim 17, wherein the glass composition has boron present as B_2O_3 , alkali oxide present as Na_2O and K_2O , and alkaline earth oxide present as CaO and MgO .

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19. The method of claim 17, wherein the glass fibers are spun to have an average diameter of from about $0.1 \mu m$ to about $3.0 \mu m$.

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